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Single-shot diffusion-weighted RARE sequence: Application for temperature monitoring during hyperthermia session

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Abstract

A diffusion-sensitive single-shot RARE (rapid acquisition with relaxation enhancement) sequence was implemented on a 2T whole-body MRI system. The sequence was optimized for diffusion-based MR thermometry, both on a conventional whole-body gradient system and on a high-performance gradient insert. The use of spin-echo versus stimulated-echo diffusion weighting is discussed as a function of gradient performance. Diffusion- based temperature mapping was used to observe the effect of the geometry of the antenna used for radiofrequency (RF) hyperthermia on the temperature distribution. Temperature changes of ± .5°C in gel and ± 2°C in a muscle sample in vitro could be detected within 16 seconds (gel) or 1 minute (muscle) at a spatial resolution of 2 x 2 x 8 mm. Temperature changes in vivo were also observed on human muscle cooled with ice with comparable sensitivity for the measured apparent diffusion coefficient (ADC) values.

Keywords

Diffusion, Hyperthermia, MRI, Pulse sequence, Temperature mapping